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Dynamic dialogue processes and controversial technologies

Case: Risk assessment and deliberate release of genetically modified crops

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1 Background

Society is becoming more risk-aware and divergences in values and interests concerning new technologies are of increasingly significant importance to the public debate. Experience indicates that the more controversial an issue is, the greater the necessity to maintain a multi-perspective dialogue between the stakeholders. However, these debates are often highly normative, reflecting the degree of aversion to risk and uncertainty of the various stakeholders involved. Authorities and their scientific advisers often find these kinds of subjective discussions quite difficult and overlook that solutions to many problems require multilateral dialogues across disciplines. However, differences in professional language and culture can make the dialogue difficult. With regards to this, Gibbons (1999) writes: "Since expertise now has to bring together knowledge that is itself distributed, contextualised and heterogeneous, it cannot arise at one specific site, or out of the views of one scientific discipline or group of highly respected researchers. Rather it must emerge from bringing together the many different 'knowledge dimensions' involved. Its authority depends on the way in which such a collective group is linked, often in a self-organised way. Breakdowns in social authority arise when links are inadequately established, as has occurred in European debates over genetically modified organisms (GMOs)". Bringing these knowledge dimensions together is not an easy task due to segregation between different epistemic cultures on the one hand, and the deliberate searching and maximisation of uncertainties on each side of areas of conflict on the other. While the last is difficult to do anything about, the former can be approached by a shift of mind, where scientists and experts openly question their own value driven assumptions.

Risk assessments are conducted to estimate how much damage or injury to human beings, the environment, or property can be expected from exposures to given risk agents, and to assist in judging whether these consequences are significant enough to require increased management or regulation. Risk assessments vary widely in scope and complexity, depending on the application, ranging from simple screening analysis to major analytical efforts that require years of work and substantial budgets. Technological risk is not a single monolithic quantity. Even the most reductive analytical approaches concede that risk is a function of two variables: the probability of a hazard and its consequences. (Stirling, 1999).

Fundamental controversies in the biosafety debate more often concern hazard identification than risk estimations. Hazard identification is the attempt to recognise the possible unwanted effects of an endeavour. When a particular gene modified (GM) crop is grown in the field the question is what consequences may be expected. Thus, the concept of risk clearly has a normative component, namely the judgement of the acceptability of the effects and consequences. Stirling (1999) identifies the risk issues related to GM technologies in agriculture as concerning: the environment, health, agriculture, the economy, society, and ethics. Crucially, these issues are measured in many different ways and many of them are irreducibly qualitative. Slovic (1998) argues that a new approach must be developed to highlight the subjective and normative nature of risk and conceptualise the act of defining and assessing risk as a game in which the rules must be socially negotiated within the context of a specific problem. Further Slovic says, "that whoever controls the definition of risk (i.e. determines the rules of the risk game) controls the rational solution to the problem at hand. If you define risk in one way, then one option will rise to the top as the most cost-effective or the safest or the best. If you define it in another way, perhaps incorporating qualitative characteristics and other contextual factors, you will likely get a different ordering of your action solutions."

2 Aim and scope

The aim of this paper is to investigate and understand the impact of choice of systems concept, systems functionality and systems boundaries in decisions and debates about controversial technologies, and on that basis contribute to the formulation of an application-oriented and transparent approach for establishing dynamic dialogue processes within the risk assessment domain that considers both rational scientific as well as normative issues. In system terms, decision-taking implies that a system concept and a system boundary has to be placed between the system of interest and its context, or environment, i.e. it is necessary to focus on some things and ignore others. The choice of system concept and boundaries forms the basis for the subsequent risk assessment, consequently

having a high impact on conclusions and results and subsequently also on decision outcomes. Theoretically, we focus on theories to elucidate and explain system concepts concerning risk assessment of controversial technologies and the lines of conflicts and interests related to risk assessment.

A cornerstone in our work is acquisition and use of knowledge in risk assessment. Our understanding is that if a technology is both complex and implicates risk assessment then the selection of experts and knowledge sources will play a special and significant role for the acceptance, diffusion and commercialisation of the technology. Further, we think that the role of experts also includes trust building between experts and the public. It has been suggested that public scepticism towards new technologies and the derived products can be overcome by consumer education. However, the Eurobarometer surveys on GM technology have shown that increased knowledge about biotechnology solely fails to promote a more positive attitude.

Our basis for discussing dialogue processes is Peter Senge (1990, p. 243) three basic conditions necessary for dialogue: suspending assumptions; regarding one another as colleagues; balancing dialogue and discussion. Suspending assumptions is probably the most challenging of the three conditions. People's assumptions are often tied closely to their deepest beliefs and values, which normally are not immediate accessible. To elucidate these more normative aspects of dialogue processes we use the concept of critical systems heuristics introduced by Werner Ulrich (1994, 1996). The concept comprises a checklist of boundary-testing questions which could be an approach to set the scientific evidence with its changing social context, in a way that examines normative judgements and considers science, risk, uncertainty and ethics as inter-related rather than separate.

With this paper we have taken the system approach and tried to define the macro system that frames the processes, actors and stakeholders of a risk assessment process. This implies that we move from a technical rational definition of a system or a process oriented approach towards a view of a system as processes of human relating that are conversational in nature. This does not mean that we abandon the technical rationale part of the system merely that we introduce the next level of the system where we try to identify not only the actors and their relationships but also how knowledge is diffused through dialogue, communication and reflection.

We have used the case of GM crops as empiricism and to describe the macro level system of the risk assessment process we have focused on three opinion forming processes that we believe to a wide extend constitute the Danish macro system namely: a) the parliamentarian process towards the formulation of a Danish legislation on GM crops; b) the general approval procedure as managed by the authorities; and c) the public debate exemplified by two Danish consensus conference (CC) on GM crops. We are fully aware that these three opinion forming processes not can be considered as equal processes. Rather, they illustrate democratic accountabilities as a social and political process and thereby bridge the notions of answerability, responsibility and responsiveness (Kearns, 1996). The parliamentarian debate is the heart of the parliamentary chain of democracy as it is conducted by those with delegated authority being answerable for their actions to the people. The outcome of the debate sets the goals and generates the criteria used in the administrative process. Formally, the administrators are subordinate to elected representatives and the administrative process aims at carrying out the agreed tasks according to agreed criteria of performance (Day & Klein, 1987). On public side the CCs are informal only providing a consultative input to the political process. Between the political and the administrative decisions the boundaries are blurred and lacking transparency emphasising the need for the development of new accounts to improve the dialogue between the public and the decision-makers.

3 Case study - background information

3.1 Legislation

The Danish parliamentary debate on the implementation of the EU directive on deliberate release of GM crops (EU directive 2001/18) took place in the spring of 2002. Act No. 131 regarding change of Act on environment and genetic engineering (implementation of the new deliberate release of GM crops)

Timetable:
- Introduction of the bill No. 131 to change the Act on environment and genetic engineering (implementation of the new directive on deliberate release of GM crops), 28 February 2002
- First reading of the bill No. 131, 11 March 2002
- Committee work and report, 8 May 2002
- Second reading of the bill No. 131, 16 May 2002
- Committee work and additional report, 27 May 2002

- Third reading and passing of the bill, 29 May 2002

The bill implements the EU directive 2001/18/EF on deliberate release of GM organisms in the environment (deadline for the implementation of the directive was 17 October 2002). With the Act, the Parliament furthermore approved to ratify the Cartagena protocol on biosafety, which regulates the cross-border transfer of living GMOs (the UN convention on biodiversity was approved 29 January 2000 and later signed by 107 countries, including all EU Member states and the EU Community; the protocol requires the ratification of 50 nation states and so far only 11 countries have ratified). In the committee working on the bill, the minister of environment promised to introduce a full stop of genetic modified organisms containing antibiotic resistant marking genes. Further, the minister of environment proposed amendments implying the minister of agriculture to lay down rules, which within the framework of the EU legislation strongly restrict the risk of dispersal to other fields, including organic fields.

The bill was passed with 111 votes (from the following political parties – the Liberal Party (V), the Socialdemocratic Party (S), the Danish People's Party (DF), the Conservative Party (K), the Socialist Party (SF), the Social Liberal Party (R), and Christian People's Party (KFR)), against 2 votes (The Danish Red-Green Alliance (EL)).

Main topics addressed in the bill:
- The principle of precaution is applicable for both approval of commercial and research cases.
- The environmental risk assessment has become more extensive and wide-ranging.
- It is required that the long-term cumulative impacts of release are included in the environmental risk assessment.
- Mandatory surveillance of first-time commercial approvals.
- Phasing out of genetic modified organisms containing antibiotic resistant genes.
- Broader public hearing procedures in commercial cases that not only include organisations and relevant authorities but also citizens. The increased public hearing is a.o. related to the Århus convention about the citizens' right to be heard in environmental cases in general (it was put into force 20 October 2001).

3.2 Administrative process

Administration of the previous law distinguished between (until 2001): 1) Release for research comprising 40 applications in Denmark out of 1600 applications in the EU according to the directive 90/220/EØF. Approval has been given to release of fodder turnip and sugar beet, rape, maize and potatoes. 2) Commercial release comprising the approval/acceptance of 18 GMOs, in which Denmark according to the common EU approval procedures has assessed all EU cases (resulting in yes in 7 cases, no in 10 cases and omission in 1 case). One commercial case (sugar beet) has been applied in Denmark, and is still under consideration. This means that no commercial release has so far been made in Denmark. No new GMOs have been approved since 1998 due to a moratorium (see Mortensen, 2003 for a historical overview). This dates back to April 1990 when the directive 90/220 was adopted and established a joint approval process for GMOs in Europe. Austria banned a GMO in February 1997 despite the EU approval. The Austrian example was followed by other national bans on GMOs in Luxembourg, France, Greece, Germany, and Italy. In June 1999 Denmark, France, Greece, Italy, and Luxembourg declared that "they will do whatever is necessary to ensure that new approvals are suspended until new rules are in place" (USDA 13/5 2003 quoted by Mortensen, 2003). The new regulatory framework for GMO approval was completed in March 2001 and entered into force in October 2002.

3.3 Consensus conferences

Consensus conferences (CC) have been developed in Denmark with the objective to establish a dialogue with ordinary citizens about assessments of new technologies and to identify conflicting interests. The CC is a dialogue between experts and citizens. The citizen panel plays the leading role and is introduced to the topic by a professional facilitator. The citizen panel formulates the questions to be taken up at the CC, and participates in the selection of experts to answer them. The expert panel is selected in a way that ensures that essential opposing views and professional conflicts can emerge and be discussed at the CC. (Andersen & Jæger, 1999). However it has been criticised that the CCs reflects the elitist tendency in the Danish debate. To illustrate this Hansen & Lassen (2001) have compared and evaluated two Danish CCs held in 1987 (Industrial and agricultural gene technology) and in 1999 (Genetically modified foods). One of their observations was that the '87 conference composition of the expert panel was balanced representing scientific experts with a positive as well as a negative attitude to GM crops, but in the '99 conference viewpoints against GM crops were solely represented by NGOs and not by representatives from the scientific community.

4 Theoretical construct

4.1 Critical systems heuristics

In an age dominated by one singular mode of knowledge production, that of institutionalised science, planning processes do not always consider the needs of those affected by the solutions; it imposes solutions upon people that are not their solutions, as they have no voice in their making. This technocratic kind of planning empower experts and those who can afford to pay them. The aim of critical systems heuristics is to give people a voice in matters that are important to them. Critical systems heuristics is a about redefining our societal notion of planning, by giving people a new understanding and competence in matters of societal change. (Ulrich, 1996)

All proposals for improvement (plans) depend on assumptions about what facts and values are to be considered and what is to be left out. Ulrich (1996) calls these assumptions boundary judgements because they define the boundaries of the planning effort. Ulrich (1994) operates with the concept purposeful system: "We designate a system S a purposeful system if S is self-reflective with respect to its own normative implications, seen from the point of view not only of the involved but also the affected, and if S has at least partial autonomy in determining its client, its purposes etc. "Partial autonomy" precludes the possibility that a system is purely extrinsically motivated; it means that the system can exercise its own will in choosing its goal".

The boundary-testing checklist contains 12 questions arranged in four groups, where all questions need to be asked both in an 'ought' mode and in an 'is' mode, see Figure 1. The 'ought' mode refers to 'vision' (what ought to be the case) and the 'is' mode can be characterised as a recording of state (what is actually the case).

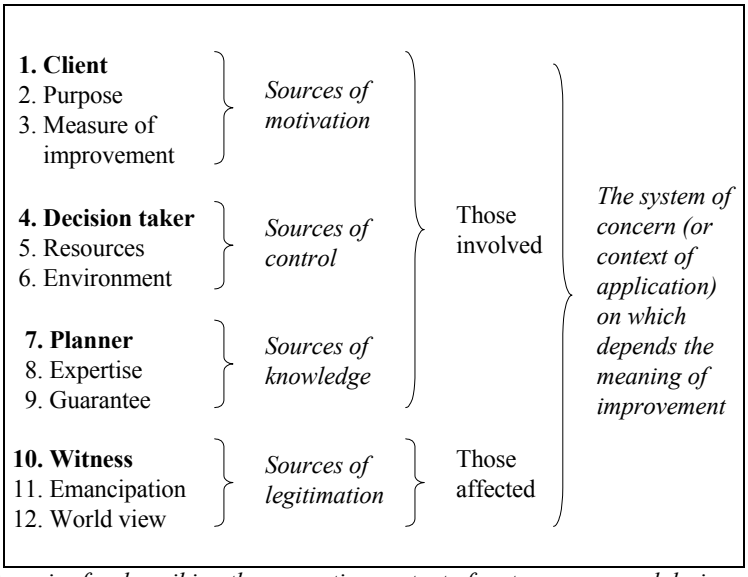

Figure 1. *Basic categories for describing the normative content of systems maps and designs (and hence the boundary judgements, or whole systems judgements, that are constitutive of such maps or designs). The first category of each group refers to a social role, the second to role-specific concerns, and the third to the related crux in regard to the boundary judgements in question. The first category of each group is basic, while the two others serve as auxiliary functions.* (Ulrich, 1994).

4.2 Systems thinking

A large conglomerate of methods, tools, and principles encompasses systems thinking, all with a common goal of understanding relationships within the system. Systems thinking is a conceptual framework for problem-solving that considers problems in their entirety. Problem-solving in this way involves pattern finding to enhance understanding of, and responsiveness to, the problem. Outcomes from systems thinking depend heavily on how a system is defined because systems thinking examines relationships between the various parts of the system. Systems thinking is championed on the premise that there are emergent properties of systems that do not exist when systems are decoupled into smaller parts (Rubenstein-Montano et al., 2001).

Defining and using systems has the following characteristics (Ossimitz, 2001):
- Thinking in models: explicitly comprehended modelling.
- Interrelated thinking: a thinking in interrelated, systemic structures.
- Dynamic thinking: a thinking in dynamic processes (e.g. delays, feedback loops, oscillations).
- Steering systems: the ability for practical system management and system control.

Systems thinking in a qualitative manner is the conceptual cornerstone to Peter Senge's (1990) vision of a learning organisation. The dimension that distinguishes learning from more traditional organisations is the mastery of certain basic disciplines or 'component technologies', they are: systems thinking, personal mastery, mental models, building shared vision and team learning.

5 Empirical work - main findings and reflections

The critical heuristic boundary-testing checklist was filled in for risk assessment related to the deliberate release of GM crops according to EU Directive 2001/18/EC. Referring to the framework of Ulrich, the plan is EU Directive 2001/18/EC. The intention of the plan is to take care of society interests related to human health (e.g. consumers, generations to come), ecological risks (e.g. environment, sustainability) and agricultural risks (e.g. manufacturers, farmers). The 12 boundary-testing questions in Figure 1 were filled in from three different opinion forming processes:
- the parliamentarian process towards the formulation of a Danish legislation on GM crops
- the general approval procedure as managed by the authorities
- the public debate exemplified by two Danish CCs on GM crops

We have structured the main findings of the boundary-testing questions into three main areas of reflection. The first refers to the social role of actors and role-specific concerns, those involved as well as those affected by the decision. Second, we critically examine the differences of the 'is' and 'ought' mode questions focusing knowledge acquisition and aspects on knowledge sources and their normative content, for the reason that selection and application of knowledge in decision processes are key issues for our problem field. In the third place, lines of interests and controversies are discussed in order to understand barriers for dialogue and for the suggestion of how to break down these barriers establishing a public arena or agora for reflections and dialogues related to technological innovation and development.

5.1 Actors and specific role-concerns

Working with and finding answers to the four basic categories of questions lead to a large amount of information sources discussing and referring actor viewpoints and roles, and/or written by actors and stakeholders themselves. In that way, complementing the checklist identified a large variety of people and institutions with relevance for the Danish system for risk assessment of GM crops. The mapping of stakeholders showed that the stakeholders having the benefits are not same as those who have to cope with the risks. The interests of the applicant (having the main benefits) are in focus. Figure 2 illustrates the system for risk assessment of GM crops in Denmark grouped in actor subsystems.

The actors and stakeholders are grouped in six subsystems on basis of their roles where each subsystem represents a role-specific concern. Within a role-specific subsystem there can be conflicting interests and lack of dialogue and a subsystem is not a representation of interests or a community with a common normative values, only a similarity in roles. As seen in the figure some actors and stakeholders are members of more than one subsystem. The actor NGO (non governmental organisations) is grouped as part of the decision-taker system due to their role in a consulting procedure performed for the approval of specific GM crops. NGOs comprise a huge variety of organisations and interests.

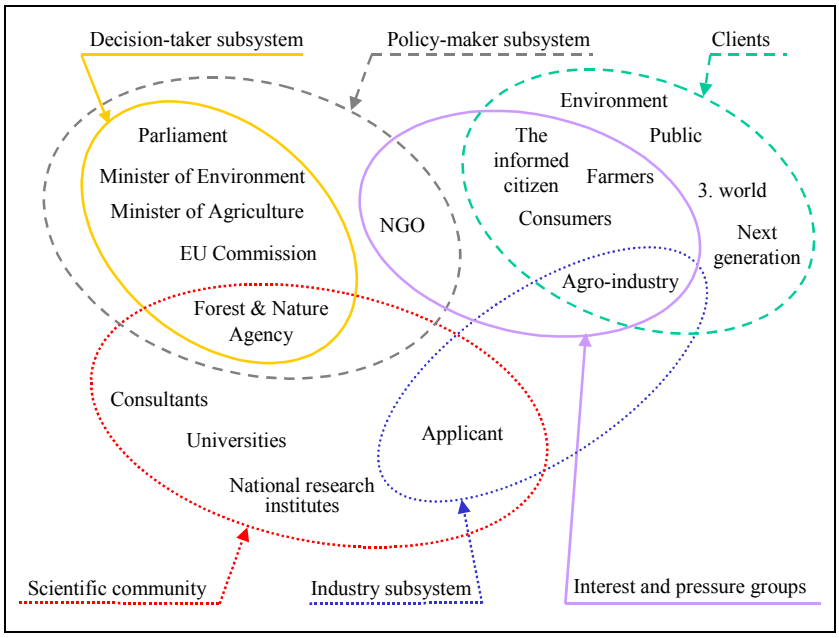

Figure 2. *Systems map showing subsystems of actors and stakeholders in the Danish system for risk assessment of GM crops.*

5.2 Knowledge acquisition and aspects of normative content

The review of 'Knowledge' information sources for both 'is' and 'ought' questions reflects as expected a large range of subjective viewpoints and attitudes. Attitudes to GM technology is influenced by persuasion, ethics, politics, culture etc. and it raises very fundamental questions concerning quality of life, e.g. transgress of barriers between species by transferring hereditary material from one species to another.

Looking at 'Knowledge' information sources the observation is that the primary knowledge sources used in risk assessment are generated by the well-established researchers, consultants and policy-makers and that knowledge and experiences coming from the plan's clients, e.g. local people or lay people, is only seldom used as an information source related to the 'is' mode questions. There is only little overlap between actors and stakeholders having influence on the normative and legislative foundation for risk decisions ('is' mode questions) and those affected by the decisions ('ought' mode questions). The lacking use of 'clients knowledge' can lead to wrong decisions or decisions without consensus which can provide a breeding ground for conflicts. If there is a major conceptual differences in values and norms between these two groups it will not necessarily become visible in a clear and transparent manner. This indicates a need for a more systematic integration and use of different types of knowledge and experience possessed by the actors and stakeholders in the 'clients' and 'interested and pressure group' subsystems. Here the post normal science context proposed by Funtowicz & Ravetz (1992) can be of relevance. They argue that in problem situations where facts are uncertain, values in dispute and stakes high it is necessary to establish a dialogue among all the stakeholders regardless of their formal qualifications and affiliations. The concept introduce ideas as 'extended peer community' and 'extended facts' to increase and qualify the knowledge acquisition.

The large weight on expert knowledge and information can lead to a kind of thinking in grooves. The role of experts can be problematic due to their use of analogous reasoning where earlier experience is stored as unconscious models to interpret new situations. Thus the more expert an individual or a group the more actions are determined by unconscious models (Stacey, 2000 p. 173), leaving experts stuck in single loop learning. The prevailing problem is how to suspend assumptions if they are unconscious ? The recent literature on organisational theory suggests 'free-flowing' conversation as a mean for reconsidering old routines and mental models. Free-flowing conversation emerges in the informal parts of the organisation or system, where a small number of people meet randomly in informal networks, e.g. in the coffee-room, in private, sports clubs etc. The distinguishing feature of free-flowing conversations is that they do not conform the official ideology. In free-flowing conversations the wisdom of decisions made is questioned, emotions are vent and boundaries of what is acceptable are tested. Stacey refers to the existence of a critical level of misunderstanding when people from two different disciplines meet. If this critical level can be achieved the different patterns of conversation (or dialogue) will cross-

fertilise and lead to new understandings (Stacey, 2000 p. 388). However if misunderstanding is too extreme, then communication fails which seems to be the case in the debate on GM technology.

The CC represents a way of coping with the increasing domination of expert and technical knowledge and an institutionalised forum for conversations between laypeople and experts. Although Hansen & Lassen question the CC ability to create a genuine discursive deliberation among experts and lay people, the CC held in '99 surfaced normative aspects after all. Thus, the citizen panel recommend that ethical issues as well as technical issues must be weighted significantly in the approval procedure. The need to broaden the coverage of risk assessments is reflected in the sources of information related to 'control' in Ulrich's system map. Risk assessments are based on traditions from natural science, but several interest and pressure groups also request the integration of assessments addressing ethical, societal, economic and legal aspects. Integrated assessment of technological risks that cover these aspects opens up for new challenges in the regulatory process. Today there is accordance between the elements assessed within the risk assessment frame and the fields of responsibility of the competent authorities in the subsequent regulatory process, but in case of broader socio-technical assessments, we have to rethink the role of the competent authorities. Research is especially needed in relation to regulatory aspects of ethical and societal concerns.

To fulfil the public demands on more comprehensive risk assessments, the policy community requires input from more than one scientific discipline in order to achieve what (Gibbons, 1999) has characterised as 'socially robust' solutions. "'Socially robust' knowledge has three aspects. First it is valid not only inside but also outside the laboratory. Second, this validity is achieved through involving an extended group of experts, including lay "experts". And third, because "society" has participated in its genesis, such knowledge is less likely to be contested than that which is merely 'reliable'" This kind of knowledge production is characterised by Nowotny et al. (2001) as a transition from mode-1 knowledge production to mode-2 knowledge production. Mode-1 knowledge is generated within a disciplinary, primarily cognitive context, while mode-2 knowledge is created within broader, transdisciplinary social and economic contexts.

That non-expert citizens can participate in technically complex public policy deliberations have been demonstrated on several occasions (Loka Institute). However, it is hardly possible to constitute a lay panel representative of a larger community as well as it is problematic to include clients knowledge when we consider events in the future where no knowledge from experience exist. Therefore, it is all the more regrettable that the CC do not give the experts opportunity to engage in conversation across different knowledge fields to allow for a genuine synthesising of the future, where ordinary citizen place the agenda.

The CCs none the less represent an opportunity to hear the voices of people who normally are not asked about their attitude on technology. An important contribution from the CCs is the information given to politicians, experts and society as a whole on the ideas and concerns of ordinary citizens (Andersen & Jæger, 1999). The question is how the CC influences on the ongoing political process. Einsiedel et al. (2001) did not find any direct political influence on the decisions taken in the Parliament or by the government, beyond the immediate comments on the final document from the head of the parliamentary committee on food.

As pointed out by representatives from the authorities in the '99 CC risk assessment always include aspects of uncertainty, which seldom can be quantified (Teknologirådet, 2000). Uncertainties should be thoroughly addressed and integrated in the assessment in order to judge whether or not to use the precautionary principle in the approval process for a specific GM crop. In a field with considerable uncertainties in assessments, there must be room for handling not intended and not expected consequences to third parties.

5.3 Lines of controversies and barriers for dialogue

Comparing the information sources found in relation to 'Motivation' and 'Control', it is thought-provoking that the actors and stakeholders whose interests the plan actually serves only to a minor extent participates in control of the plan. The politicians advocating for different interest groups and clients are elected by the people, so according to the democratic principles inherent in our political system this is how 'Clients' are represented. But in practice, it is a democratic problem that the public often disagrees on the decisions taken by the authorities. The interesting point in Figure 2 is the subsystem 'Clients' whose interests actually should be served by the risk assessment and the approval procedure. This subsystem is to a large extent separated from the other subsystems and only linked to the rest of the risk assessment system through personally informal networks and the not very well-defined subsystem covering interest and pressure groups.

Our democratic system may not be perfect but extending the dialogue before political decision-making (e.g. through CC) and in relation to the administration of the law (through public hearing procedures) the traditional democratic processes are improved. The CC can be seen as an instrument to hear citizens prior to decision processes, but it does not necessarily strengthen the links between the subsystems. In the '99 CC the lay panel witnessed a staged confrontation of the different positions (Hansen & Lassen, 2000) hampering the possibilities of a genuine discursive deliberation among experts and lay people. Moreover, the CC do not allow for dialogue among the experts delimiting the free-flowing conversation that might lead to synergy and new realisation among them. Whether the CC has had any discursive impact on the ongoing discussions among experts is difficult to assess. However, since the dialogues on complex issues often stay inside epistemic frames due to differences in professional language and culture, appropriate action beyond the CC probably has to be taken to bring down this barrier and to stimulate free-flowing conversation between experts.

The actor subsystems are only to a minor degree formally linked and an active effort is needed to break down the barriers and bring the subsystems closer to each other. The dialogue between actor subsystems depends to a large extent on personal initiatives and networks. A major conclusion from the CC was the need for a dialogue on GM crops. Thus it was pointed out that frames for debates between pro-GM actors and worried citizens are lacking. Indeed in the conference manifesto the panel asked for the establishment of an ethical committee whose deliberations would receive weight equal to that given to technical considerations.

Between actor subsystems and within actor subsystems there can be conceptual differences in norms and interests. Fundamental controversies in the biosafety debate are e.g. lack of consensus on hazard identification, where one example is to which extent long-term effects should be included in risk assessments. Several NGOs argue that long-term effects are not accounted for within the current risk assessment practice. The lack of clarification, transparency and openness of the normative content of viewpoints and attitudes is a source for misunderstanding and mistrust between actors and subsystems.

The parliamentary debate on the implementation of the EU directive 2001/18 reveals a subgroup of sceptical supporters comprising S, DF, SF, RV, and KRF. An opponent is EL, while the government parties of V and KF are full supporters. The supporters highlight the public hearing procedures included in the bill, the stricter risk assessment and the time constrained approval, but some of the scepticals also ask about how to decide on risk assessment, how to monitor the development and how to make public hearings.

After the first reading of the bill, a majority (S, V, DF, KF, RV, and KRF) proposes the bill for acceptance. S, RV, and KRF are pleased that the government does not intend to change the moratorium, but are concerned about the dispersal of GMO to other fields. A minority (SF) will clarify its position in 2nd reading, and a minority (EL) rejects the bill. The first round of committee work includes seven meetings, hearing, consultation in Parliament with two questions to the Minister of Environment and Minister of Agriculture as well as written responses to 39 questions raised by the committee. After the second reading of the bill the committee work include another three meetings and seven new questions. All in all the parliamentary process comprises formal procedures for taking into account both expert advise as well as opinions from laypeople. The way however which experts to build responses on, is not necessarily transparent.

It should also be mentioned that in July 2003 some of the sceptical supporters together with the opponents (S, DF, SF, and EL) forced the Minister of Agriculture to reject the proposal of the EU Commission on marketing of GMO and feedstock until the Commission has proposed rules for compensation to organic farmers if GMOs are dispersed to their fields. The main conflict line is thus still on what are the criteria for lifting the moratorium, including traceability and labelling of GMOs.

6 Discussion

6.1 Critical systems heuristics and dynamic dialogue processes

Ulrich's checklist aims at a transparent normative mapping of assumptions, attitudes and interests of the different groups of actors and stakeholders. The approach asking questions in 'ought' mode as well as 'is' mode can be an eye opener to the traditional way of thinking what concerns the basic conditions and set-up for a decision process. It opens up for a challenging examination and discussion of the idea of a purposeful system where the participants are forced to see their own attitudes and assumptions together with others as equal inputs to the formulation of the problem situation.

Specific stakeholders have specific experiences that sample relative small portions of the complete system, which may be very complex in nature. Carl Weick describes such partial observations as stuff of which individual reflections are made. He claims that the most accurate way to portray these opposing reflections on the same experience is to say that the experience is equivocal. About equivocal Weick (2001 p. 313) elaborates: "[it] does not mean unclear or uncertain; rather it means that there are two or more clear, distinct meanings for several related variables because the relationships among them differ." Thus emphasis is on cognitive relations between uncertain events and existing concepts. Weick advocates that it is the act of sharing that distinguishes organisational cognition from individual cognition, and it is through dialogue members in the organisation join together to perform as a cognitive mechanism which allows their organisation to 'see and think' through their 'collective mind' (Weick & Roberts, 1993). Weick describes communication as a process of uncertainty reduction and claim that we organise in order to create "sense-making" environments that have a workable level of certainty.

Peter Senge has worked with the application of dialogue in fostering organisational learning. Creativity in this perspective is a learning experience that grows out of dialogue between people from multiple constituencies. This means that we have to face the difficulties for dialogue between scientific disciplines in a broader context. However, Senge's necessary conditions for dialogue have been formulated within a perspective of a single organisation. We are looking at a complex macro system where the boundaries between the system and its environment are diffuse and with a need to wire knowledge that is distributed, contextualised and heterogeneous. Ulrich's framework focusing the normative content of dialogue offers an asset to one of Senge's necessary conditions 'suspending assumptions'. However, we find it an open question to which extent the framework is applicable for calling attention to the underlying interests bound within the specific scientific traditions.

6.2 Systems thinking and systems boundaries

The aim of system definition is to explain and describe the content and concepts of the problem to be analysed. One of the crux issues in systems thinking is that people often have a problem with 'seeing' the system and delimit the system and target groups. Risk related issues can emerge and be motivated by substantial different reasons and purposes, and it can be hard to reach consensus about problem framing. According to Carr & Levidow (2000), Ulrich's boundary-testing checklist can be a powerful way of challenging decisions, by revealing the decision-takers' unspoken assumptions and values. Our experience is that the thinking in 'is' and 'ought' mode questions can be a strong approach to identify those parts of the system where divergences exist between how the system actually is working and the ideal working system.

Systems thinking is essential for both Senge and Ulrich. Ulrich's intention is to design a purposeful system which is responsible and critical reflective with high focus on valuation and the capacity for modifying the normative content of the system. According to Senge, systems thinking teaches that there are two types of complexity: detailed complexity and dynamic complexity. Many systems are designated to handle detailed complexity, i.e. the sort of complexity in which there are many variables. The second type of complexity is dynamic situations where cause and effects are subtle, and where effects over time of interventions are not obvious. The complexity characterising decisions about GM crops is both detailed and dynamic. Therefore measures must be taken ensuring the system to consider both types of complexity: detailed complexity mostly related to specific risk assessments and dynamic complexity predominantly dealing with the generic and principal issues.

In systems thinking important elements are systemic structure (boundaries, functionality, actors, relations, etc.) and dynamic processes (behaviour, direct and indirect effects, management, system-oriented actions, etc.). Ulrich's approach is mainly addressing systemic structure focusing the ideas of a purposeful system (see section 4.1) and the establishment of a system, which is self-reflective with respect to its own normative implications. The dynamic processes are not in focus. In Senge's (1990) vision of a learning organisation one of the essential points is to see organisations as a dynamic process. Senge's mapping process is not as formalised and structured as Ulrich's making it difficult to use the learning organisation concept to develop systems maps also comprising dynamic processes.

A crucial point of systems thinking is the choice of an appropriate form of representation. How is the system, its systemic structures and relations, its boundaries and its dynamic processes described and presented to the interested and affected actors and stakeholders. The system map sets up the context and concepts of the problem to be analysed and therefore it is essential that they are presented in an accessible, understandable and transparent manner.

6.3 Application of scientific advice in risk assessment

Risk assessment of controversial technologies has raised an increased interest on the relations between science and policy communities. The science content of public policy decisions is growing rapidly, which can lead to fundamental changes in how scientists and policy analysts work with and relate to each other. The Canadian Centre for Management Development (CCMD) argues that a new paradigm is needed in order to integrate science and policy and achieve common purpose (CCMD, 2002). Achieving a common purpose is strongly depending on interaction between science and policy communities. According to CCDM there are two types of communication gaps: "1) a lack of regular, formal and informal dialogue between scientists and policy groups; 2) difficulties arising both from differences in the languages in which science and policy information is transmitted, and difficulties in understanding the scientific content of the message". The importance of informal dialogue is in accordance with the ideas on 'free-flowing' conversations proposed by (Stacey, 2000) (see section 4.2). Providing and application of scientific advice in policy processes can involve a variety of actors with different roles and responsibilities, and the establishment of informal networks is strongly depending on mutual awareness and respect of the differences in roles and areas of responsibilities.

Public debates on controversial technologies and risk assessment are often strongly emphasising information and attitudes to uncertainty and utility value. Therefore, the policy community must be better informed about uncertainty and imperfect knowledge of scientific knowledge. Further, it is essential that the policy community is capable of understanding and explaining the normative basis of their own advises to the political community. Bier (2001) has pointed out that communication of risk to policy-makers and decision-takers has not received nearly as much research attention as has communication of risk to the general public. Communication between experts and the policy community might be an area for improvement.

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